Lesson 5

Traffic congestion

The Effects of Consumption

In this lesson students consider the effects of the manufacturing process on natural systems. The class looks at a series of photographs showing places before and after extraction, farming, and the processing of raw materials have taken place.

The photos serve as a prompt for a discussion about the effects of these activities on ecosystems. Students apply their knowledge of deserts, forests, grasslands, and riparian areas to infer how the living things, soil, and water in an area can be influenced by the manufacturing process.

The lesson also looks at air pollution, focusing on the emissions of vehicles used in the transportation of materials and machines used in extraction, harvesting, and processing of materials at refineries and factories. Students apply their understanding of the environmental effects of natural resource consumption for manufacturing to the choices they make in the design of their toys.

Learning Objective

Provide examples of how the methods used to extract, harvest and transport natural resources, and consume them (or make useable products) affect natural systems.

Background

Each phase of the manufacturing process requires inputs and results in outputs.

Inputs, such as natural resources, energy, and human labor, go into the creation of an object. Outputs, such as the end product as well as such byproducts as pollution, wastes, and excess materials, result from the production process.

Both the inputs and outputs of manufacturing affect natural and human systems. These effects can be positive, negative, or neutral, depending on the product and the system. Consumers who study the inputs and outputs associated with the products they buy can determine how their purchases affect natural and human systems.

Pollution that directly or indirectly results from the manufacturing process may influence the health of organisms and ecosystems. Hazardous wastes (defined by the Environmental Protection Agency as ignitable, corrosive, reactive, or toxic solids or liquids) sometimes form as byproducts of a variety of stages of manufacturing. Today the burning of fossil fuels in motor vehicles, power plants, and factories—often for everyday manufacturing activities—represents the largest source of air pollution globally.

With the Clean Air Act (1963, 1970, 1990) the United States has attempted to prohibit toxic emissions and reduce air pollution. Innovations such as the catalytic converter and clean-burning fuels have also reduced the toxicity of motor vehicle exhaust; however, some people argue that current regulations must be strengthened.

Emissions standards and hazardous waste regulations vary from country to country. The governments of some countries, including those that supply United States manufacturers with raw materials, do not always impose or enforce emission regulations on their extractors, harvesters, or manufacturers. In this way, some vehicles, machines, power plants, chemical plants, refineries, and factories used in other countries, and depended upon by American manufacturers and consumers, may be operating in ways that do not comply with U.S. emissions and resource protection standards. The outputs of the manufacturing process and human consumption have become an international issue that necessitates international cooperation to solve.

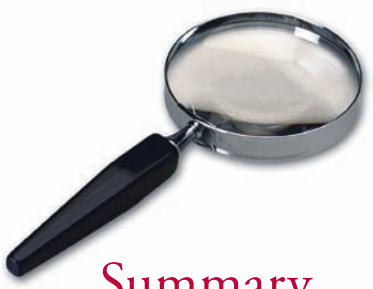
Electrical power plant

Key Vocabulary

Air Pollution: Contamination of the atmosphere, specifically the layers near the surface.

Emissions: Discharges of gaseous, solid, or liquid waste matter released during a process such as manufacturing or transportation.

Toolbox



Summary of Activities

After viewing and discussing photographs of areas influenced by the manufacturing process, students consider the variety of ways human consumption can influence natural systems, including the creation of air pollution.

Instructional Support

See Unit Resources, page 28

Prerequisite Knowledge

Students should know about:

- air as a mixture of gases, including oxygen, which many living things need to breathe.
- the characteristics of desert, forest, marine, grassland, and riparian ecosystems.

Students should have:

- completed previous lessons.

Advanced Preparation

Gather and prepare Activity Masters:

- Gather from previous lessons:
  - Student **Manufacturing and Design Journals** (individual student's copies)

Gather and prepare Visual Aids:

- Prepare transparencies.
- Display a world map in a central, visible place in the classroom that can be easily accessed by students.

Materials Needed

Activity supplies:
- World Map

A-V equipment:
- Overhead projector or LCD projector, screen

Class supplies:
- Construction paper (one piece in a dark color)

Visual Aids

Transparencies:
- **Before and After: Copper Mining**, Visual Aid #16
- **Before and After: Cotton Farming**, Visual Aid #17
- **Before and After: Oil Drilling,** Visual Aid #18
- **Before and After: Silica Mining**, Visual Aid #19
- **Before and After: Forest Clear-Cutting**, Visual Aid #20
- **Air Pollution**, Visual Aid #21

Duration

Preparation Time
20 min.
Instructional Time
60 min.

Safety Notes

None

Activity Masters in the Supporting Materials (SM)

Before and After Notes
SM, Page 34
One per student

Procedures

Step 1

Ask students to think about the extractors and harvesters learned about during the previous lesson. Ask them to picture the tools they used, the steps they took to get to the resources they needed, and what they did once they found those resources.

Ask students, "Where in the world would you see these harvesters and extractors working?" Have students share some of their answers by pointing to areas of the world map.

Step 2

Tell students they are going to visit some of those areas in two trips. On the first visit they will see the place before people extract natural resources. On the second visit they will either witness the extraction of the resources or see the area after extraction has taken place.

Distribute **Before and After Notes** (Lesson 5 Activity Master) to each student. Tell students to take notes on the changes they see in their travels that seem to result from the extraction or harvesting of resources.

Step 3

Project the transparency of **Before and After: Copper Mining** (Visual Aid #16), with only the "Before" side of the transparency visible to students. (*Note: Use a piece of dark construction paper to cover up the "After" side.*) Ask students, "Can you describe the ecosystem you see? (*A desert)* Ask them, "What parts of the natural system do you see?" (*Plants, rocks, soil, air, and sun*)

Uncover the "After" side of the transparency**.** Ask students, "What do you see now?" (The *plants are gone and the ground has been dug into layers. There is a large pit with smaller pits at the bottom.*) Ask, "How do you think the desert ecosystem has been changed by the copper mine?" (*Plants and animals do not live where the mine is; the ground and soil have been changed and may not be as healthy as they were before.*)

Give students time to write notes about the changes they see on the handout **Before and After Notes** under Copper Mining before moving on.

Step 4

Following the same process as 3, display, discuss, and give students time to take notes on the other before-and-after scenarios: **Before and After: Cotton Farming** (Visual Aid #17), **Before and After: Oil Drilling** (Visual Aid #18), **Before and After: Silica Mining** (Visual Aid #19), and **Before and After: Forest Clear-Cutting** (Visual Aid #20).

Step 5

After reviewing all of the transparencies, ask students, "What do you think is the biggest change that happens to a natural system as a result of people making natural resources into products?" (*Answers may vary.*) Tell students that the effects are very different depending on the type of resources being used, for example mining results in large holes in the ground, waste rock piles, and sometimes chemicals and other pollutants being released into the air or water.

Write "air pollution" on the white board. Ask students, "What does this word mean to you?" (*Answers will vary).* Write students' contributions on the board around the term and explain that air pollution cannot always be seen. Ask students to raise their hands if they have heard the word "smog" before (*Students raise their hands).* Tell students that smog is only one form of air pollution, one that people can easily see.

Project the transparency of **Air Pollution** (Visual Aid #21). Ask students, "What are some sources of the type of smoke you see in this picture?" List student responses on the white board. (*Factories, burning things, exhaust from machines and cars, airplanes, trains and ships.*)

Step 6

Write the word "emissions" on the white board among the contributions the class made around the term "air pollution." Explain to students that emissions are gases and particles that are released into the air. Tell students that some emissions contribute to smog and other ecosystem problems, such as acid rain. Acid rain forms when sulfur dioxide dissolves into rain water and falls to the ground. Acid rain droplets damage plants, animals, and human-made structures. A lot of sulfur dioxide is released into the air when people burn petroleum products as fuel in machines, cars, planes, trains, trucks, and ships.

Tell students that smog also causes health problems for animals and humans. The particles in the air on smoggy days can induce asthma attacks, wheezing, and other lung problems.

Step 7

Distribute student **Manufacturing and Design Journals** (individual student's copies). Ask students to turn to pages 19–20 (The Toy's Effects) and read the instructions. Have students complete the task using their notes from today's lesson and any other pages of their journal that could be helpful. When students have finished, collect the journals and their **Before and After Notes** for use in assessment.

Lesson Assessment

Description

In this lesson, students explore the effects of extraction, harvesting, transportation, and consumption of natural resources on natural systems. Students observe and take notes on the effects of the extraction and harvesting of five popular resources in **Before and After Notes** (Lesson 5 Activity Master). They apply this understanding to their own mock manufacturing processes on pages 19–20 of their **Manufacturing and Design Journals** (individual student's copies) as they answer a series of questions.

Suggested Scoring

Each question on pages 19–20 (The Toy's Effects) in the **Manufacturing and Design Journal** is worth 2 points. With 5 questions, there is a possible total of 10 points for the assignment. Sample answers are provided in the Answer Key on pages 105–106.

Student notes on **Before and After Notes** should be checked for completeness and accuracy. Sample answers are provided on page 107.

Answer Key and Sample Answers

The Toy's Effects

Today's Task

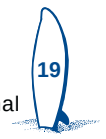
Answer the following questions about how the creation of your toy could affect natural systems. Include at least **two examples** in each of your answers.

1. How can **extracting** or **harvesting** the resources used in your toy affect ecosystems?

   The wood in my baseball bat comes from trees that were cut from a forest. Taking the trees away means that animals living in the tree will have to live somewhere else and the forest will have fewer trees. The resin on the outside of the bat comes from oil that was drilled from an area that was cleared of plants before the oil came out.

2. How can **transporting** the resources to the factory that makes your toy affect ecosystems?

   The wood and the petroleum used in my bat were transported by trucks that give off emissions, creating air pollution. The roads that the trucks drive on change the landscape. There used to be plants and animals where the roads are now, but people removed them.



Manufacturing and Design Journal

The Toy's Effects

3. How can **making** your toy in a factory affect ecosystems?

The machines in the factory where my bat is made give off emissions that can create air pollution.

4. How can **transporting** the finished toy to stores affect ecosystems?

Trucks probably take the bats to the stores and they give off exhaust that can cause air pollution. The roads they drive on change ecosystems because people removed plants and animals to build the roads.

5. Can your toy affect ecosystems after it is used? How?

Yes, the bat might be broken and then thrown away in a landfill or burned. The landfill gets full, and the burning can pollute the air.

Manufacturing and Design Journal

Answer Key and Sample Answers

Before and After Notes

Lesson 5 Activity Master

Name: _____

Before and After: Copper Mining

17 **Before and After: Cotton Farming**
Visual Aid — Transparency

Before and After: Cotton Farming

Before and After: Oil Drilling

19 **Before and After: Silica Mining**
Visual Aid — Transparency

Before and After: Silica Mining

20 **Before and After: Forest Clear-Cutting**
Visual Aid — Transparency

Before and After: Forest Clear Cutting

21 **Air Pollution**
Visual Aid — Transparency

Air Pollution in Cairo, Egypt